

Chapter
1

**WINDOWS 2003
PLATFORM AND
ARCHITECTURE**

*Get on the
Fast Track!*



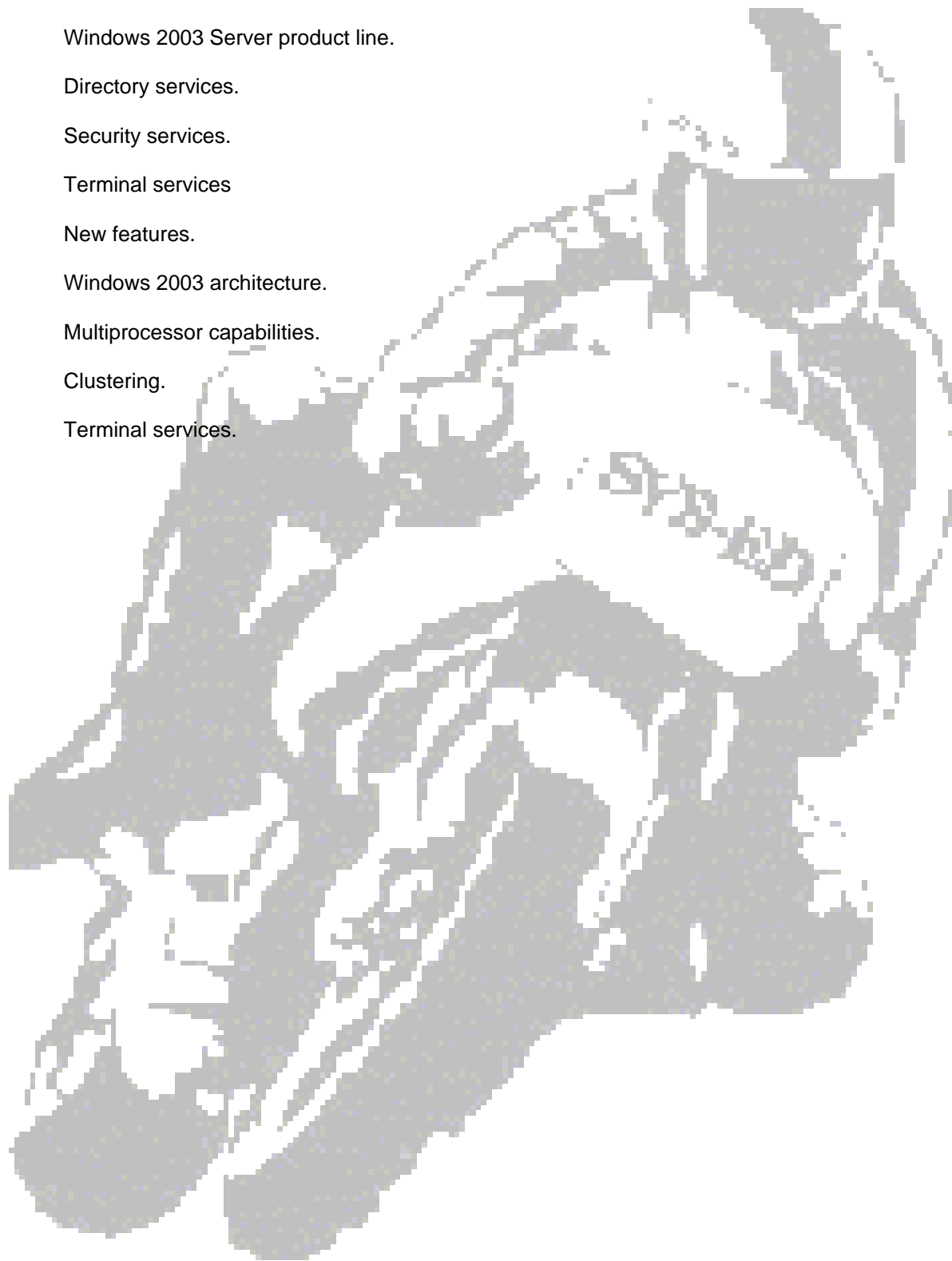
TM

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COMPUTER
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Objectives

You will learn:

- C Windows 2003 Server product line.
- C Directory services.
- C Security services.
- C Terminal services
- C New features.
- C Windows 2003 architecture.
- C Multiprocessor capabilities.
- C Clustering.
- C Terminal services.



1 Windows 2003 Server Product Line

The Windows Server 2003 family is comprised of the following products:

| Product | Description |
|-----------------------|--|
| Standard Edition | <p>Designed for departmental and standard workloads:</p> <ul style="list-style-type: none"> C Support for file and printer sharing. C Internet connectivity and security. C Centralized desktop application deployment. |
| Enterprise Edition | <p>Designed for mission-critical server - applications, web services, and infrastructure workload tasks:</p> <ul style="list-style-type: none"> C Operating system support for up to 8 processors. C Eight-node clustering and support for up to 32 GB of memory. C Intel Itanium-based computers. C Support for 64-bit computing platforms with the capabilities for up to 8 processors and 64 GB of RAM. |
| Datacenter Edition | <p>Designed for scalability and reliability:</p> <ul style="list-style-type: none"> C Support for up to 32-way SMP and 64 GB of RAM with the 32-bit version. C Support for up to 128-way machines with individual partitions of up to 64 processors and 512 GB of RAM with the 64-bit version. C Both 8-node clustering and load balancing services as standard features. C Windows System Resource Manager to facilitate consolidation and system management. |
| Web Edition | <p>Provides dedicated web serving and hosting:</p> <ul style="list-style-type: none"> C A platform for building and hosting web applications, web pages, and XML web services. C Primary use as an IIS 6.0 web server. C Platform for rapidly developing and deploying XML web services and applications that use ASP.NET technology. C Ease of deployment and management. |
| Small Business Server | <p>Provides an integrated suite of server products. There is a Standard Edition and Premium edition of the product.</p> |

1.1 Windows Server 2003 Enterprise Edition

Windows Server 2003, Enterprise Edition, is for servers that run applications such as networking, messaging, inventory, customer service systems, databases, and e-commerce Web sites. It is available in both 32-bit and 64-bit versions.

Windows Server 2003, Enterprise Edition, differs from Windows Server 2003, Standard Edition, primarily in its support capability to cluster servers for greater load handling.

Windows Server 2003, Enterprise Edition, provides support for:

| | |
|-------------------------------------|--|
| Eight-way symmetric multiprocessing | Server performance and capacity can be increased by adding processors. Up to eight processors in a single system or partition are supported. |
| Eight-node clustering | Server clusters up to eight nodes are available only in Windows 2003, Enterprise Edition, and Windows 2003, Datacenter Edition. |

The following additional improvements have been made:

- C Network load balancing.
- C Active Directory service technologies have been improved over a wide area network through improvements in the synchronization and replication as well as credential caching in domain controllers.
- C Security functionality - Internet Information Services (IIS), public key infrastructure (PKI), and Kerberos, smart cards and biometrics.

2 Windows 2003 Product Family: Feature Set

The hardware requirements for the Windows Server 2003 family is dependent upon the feature set and configuration.

| Feature | Standard Edition | Enterprise Edition | Datacenter Edition | Web Edition |
|--|------------------|--------------------|--------------------|---------------|
| 64-bit Support for Intel Itanium - Based Computers | Not supported | Supported | Supported | Not supported |
| Hot add memory ^{2, 3} | Not supported | Supported | Supported | Not supported |
| Non-Uniform Memory Access (NUMA) ³ | Not supported | Supported | Supported | Not supported |
| Datacenter Program | Not supported | Not supported | Supported | Not supported |
| 2 GB RAM Maximum | Not supported | Not supported | Not supported | Supported |
| 4 GB RAM Maximum | Supported | Not supported | Not supported | Not supported |
| 32 GB RAM Maximum | Not supported | Supported | Not supported | Not supported |
| 64 GB RAM Maximum | Not supported | Partially | Supported | Not supported |
| 512 GB RAM Maximum | Not supported | Not supported | Partially | Not supported |
| 2-way SMP | Supported | Supported | Not supported | Supported |
| 4-way SMP | Supported | Supported | Not supported | Not supported |
| 8-way SMP | Not supported | Supported | Supported | Not supported |
| 32-way SMP | Not supported | Not supported | Supported | Not supported |
| 64-way SMP | Not supported | Not supported | Supported | Not supported |

2.1 Directory Services

| Feature | Standard Edition | Enterprise Edition | Datacenter Edition | Web Edition |
|--------------------------------------|------------------|--------------------|--------------------|---------------|
| Active Directory | Supported | Supported | Supported | Partially |
| Metadirectory Services (MMS) Support | Not supported | Supported | Supported | Not supported |

2.2 Security Services

| Feature | Standard Edition | Enterprise Edition | Datacenter Edition | Web Edition |
|--|------------------|--------------------|--------------------|---------------|
| Internet Connection Firewall ² | Supported | Supported | Not supported | Not supported |
| Public Key Infrastructure, Certificate Services, and Smart Cards | Partially | Supported | Supported | Partially |

2.3 Terminal Services

| Feature | Standard Edition | Enterprise Edition | Datacenter Edition | Web Edition |
|-----------------------------------|------------------|--------------------|--------------------|---------------|
| Remote Desktop for Administration | Supported | Supported | Supported | Supported |
| Terminal Server | Supported | Supported | Supported | Not supported |
| Terminal Server Session Directory | Not supported | Supported | Supported | Not supported |

2.4 Clustering Technologies

| Feature | Standard Edition | Enterprise Edition | Datacenter Edition | Web Edition |
|------------------------|------------------|--------------------|--------------------|---------------|
| Network Load Balancing | Supported | Supported | Supported | Supported |
| Cluster Service | Not supported | Supported | Supported | Not supported |

2.5 Communications and Networking Services

| Feature | Standard Edition | Enterprise Edition | Datacenter Edition | Web Edition |
|---|------------------|--------------------|--------------------|---------------|
| VPN: Virtual Private Network Support | Supported | Supported | Supported | Partially |
| IAS: Internet Authentication Service | Supported | Supported | Supported | Not supported |
| Network Bridge ² | Supported | Supported | Not supported | Not supported |
| ICS: Internet Connection Sharing ² | Supported | Supported | Not supported | Not supported |
| IPv6 | Supported | Supported | Supported | Supported |

2.6 File and Print Services

| Feature | Standard Edition | Enterprise Edition | Datacenter Edition | Web Edition |
|---------------------------------|------------------|--------------------|--------------------|---------------|
| DFS: Distributed File System | Supported | Supported | Supported | Partially |
| EFS: Encrypting File System | Supported | Supported | Supported | Supported |
| Shadow Copies of Shared Folders | Supported | Supported | Supported | Supported |
| Removable Storage | Supported | Supported | Supported | Supported |
| Remote Storage | Not supported | Supported | Supported | Not supported |
| Fax Service | Supported | Supported | Supported | Not supported |
| Services for Macintosh | Supported | Supported | Supported | Not supported |

2.7 Management Services

| Feature | Standard Edition | Enterprise Edition | Datacenter Edition | Web Edition |
|--|-------------------------|---------------------------|---------------------------|--------------------|
| IntelliMirror | Supported | Supported | Supported | Partially |
| Group Policy Results | Supported | Supported | Supported | Partially |
| WMI: Windows Management Instrumentation Command Line | Supported | Supported | Supported | Supported |
| Remote OS Installation | Supported | Supported | Supported | Supported |
| RIS: Remote Installation Services | Supported | Supported | Supported | Not supported |
| WSRM: Windows System Resource Manager | Not supported | Supported | Supported | Not supported |

2.8 .NET Application Services

| Feature | Standard Edition | Enterprise Edition | Datacenter Edition | Web Edition |
|---|------------------|--------------------|--------------------|---------------|
| .NET Framework ² | Supported | Supported | Supported | Supported |
| Internet Information Services (IIS) 6.0 | Supported | Supported | Supported | Supported |
| ASP.NET ² | Supported | Supported | Supported | Supported |
| Enterprise UDDI Services | Supported | Supported | Supported | Not supported |

2.9 Multimedia Services

| Feature | Standard Edition | Enterprise Edition | Datacenter Edition | Web Edition |
|------------------------|------------------|--------------------|--------------------|---------------|
| Windows Media Services | Supported | Supported | Supported | Not supported |

- ¹ Applies to 64-bit versions only.
- ² Not supported in 64-bit versions of Windows Server 2003.
- ³ May be limited by lack of support by OEM hardware.
- ⁴ Both the 32-bit version of Datacenter Edition and the 64-bit version of Enterprise Edition support up to 64 GB RAM.
- ⁵ The 64-bit version of Datacenter Edition supports up to 512 GB RAM.

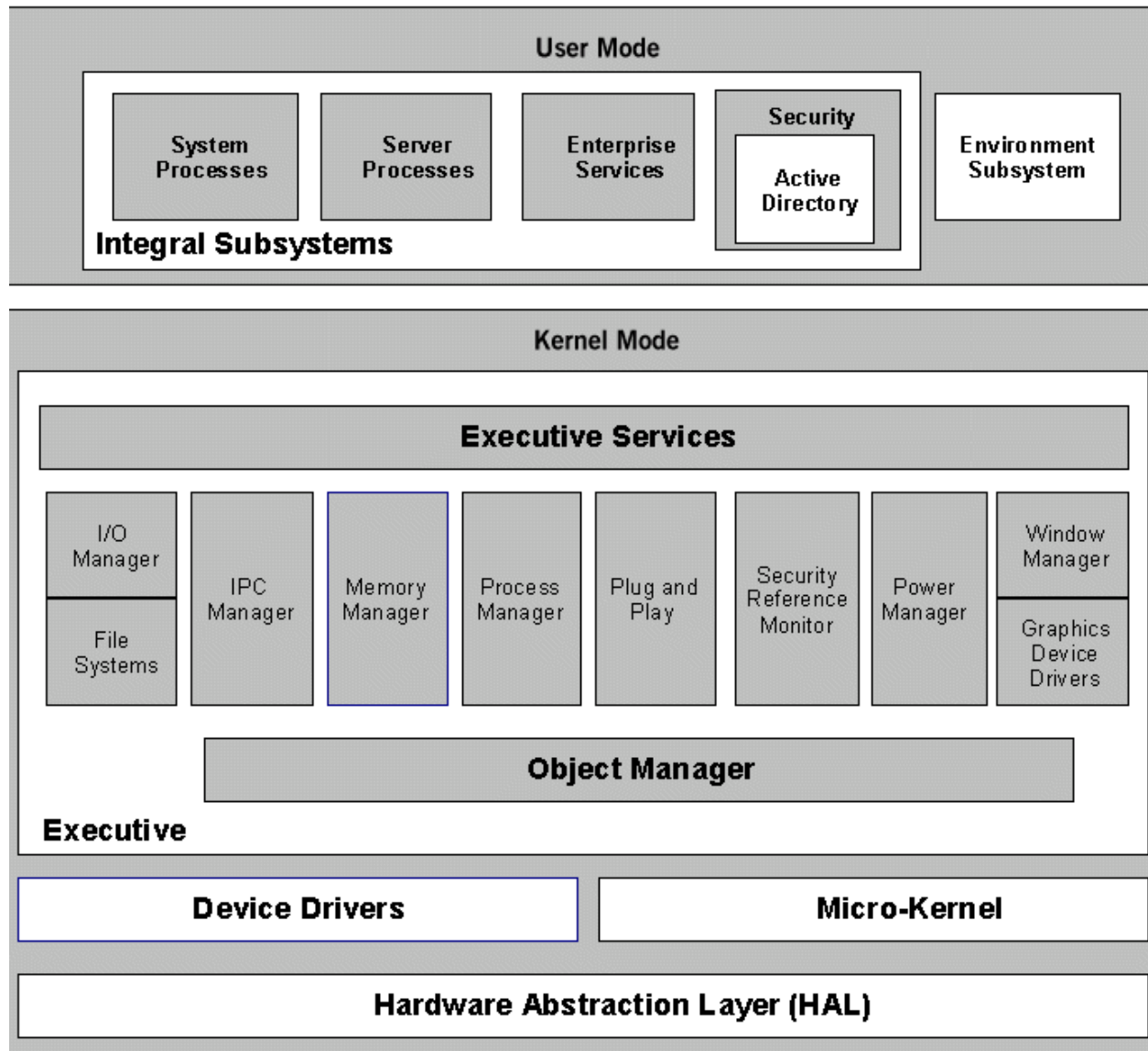
3 New Features

The following new features and technologies have been added to Windows Server 2003.

| Feature | Description |
|-----------------------------------|--|
| Active Directory | Provides the means to manage the identities and relationships that make up network environments. |
| Clustering Technologies | Clustering technologies provide significant improvements in enhanced network features and greater failover capabilities and high system uptime. |
| Internet Information Services 6.0 | The IIS architecture in the Windows server operating systems has been revised. |
| Storage Management | Enhanced management and maintenance for disks and volumes, backup and restore data, and connecting to storage area networks - SANS. |
| Terminal Server | New options for application deployment access to data over low bandwidth which will enhance the value of legacy and new, lighter-weight devices. |
| Windows Media Services | Used for distributing digital media content over corporate intranets and the Internet. |
| Enterprise UDDI Services | Discovery, sharing, and reuse of XML Web services and other programmable resources. |

4 Windows 2003 Architecture

Windows Server 2003



5 Kernel Architecture

Microsoft Windows 2003 is composed of different layers that interact to present the user with a complete operating system. At the core of this architecture lies the kernel which has special rights over the hardware of the system.

The kernel is responsible for:

- C allocating memory to applications.
- C communicating with device drivers.
- C determining which processes run at any given time.

The kernel allows the operating system to scale higher, supporting up to 64 processors and 512 GB of RAM, depending on the edition of Windows Server 2003. It allows database applications like Microsoft SQL Server to take advantage of that larger hardware, and increases their performance by moving pieces of functionality into the kernel itself.

Applications depend on the kernel to allocate memory, processor time, and hardware resources.

Microsoft has changed several aspects of the kernel:

- C Windows Server 2003 scales much higher than was possible with older versions.
- C Network applications are more reliable and will run more efficiently.
- C Users in other countries will have an easier time using the operating system and its applications in their environments.

Features such as processor quotas and process accounting make Windows Server 2003 an extremely attractive platform for web hosting environments.

Clustering features are built into the kernel, allowing for greatly improved uptime in networks where redundancy is available.

Process and Sessions

Windows 2003 launches a separate Win32 process for each user session. This ensures that applications do not communicate between user sessions, eliminating potential violations of a user's privacy. These kernel changes will not affect administrators who choose not to use Terminal Services.

Windows 2003 Win32 Architecture

The Windows 2003 Win32 subsystem is capable of handling multiple user sessions.

6 Kernel Facilities

6.1 Processor Quotas and Accounting

It is common practice for Internet Service Providers (ISPs) to share a single Web server between many customers.

Two features make multiuser environments more effective:

- C Processor accounting.
- C CPU throttling.

Processor accounting is used by IIS to record the number of processor cycles consumed by individual Web requests. This allows ISPs to bill based on processor usage, and enables developers to determine which pages can most benefit from optimization.

CPU throttling stops a Web site's out-of-process applications from stealing so much processor time that the other Web sites cannot function correctly.

The job object is the underlying technology that enables processor accounting and CPU throttling. Services such as IIS spawn many processes so that multiple tasks can be accomplished at the same time. While multiple processes improve performance, they make it complicated to track which processes are associated with which tasks. Because older versions of IIS supported many virtual servers sharing the same application space, it was impossible to audit or control how much processor resources each virtual server consumed.

Job objects allow the operating system to manage groups of processes as a single unit. This makes it much easier for applications to monitor and throttle the amount of processor time that separate tasks consume. This feature is critical for environments where multiple customers share the same server.

One or more processes can work together to complete a single job, which is represented by a job object.

6.2 Spin Count

Spin count is a method for improving performance on multiprocessor systems when multiple programs need access to the same resources simultaneously.

Spin count controls how many times a process will attempt to access a resource before waiting.

On a single processor system, the different processes will have to wait for each other to execute anyway, in which case repeated attempts to access the resource will not be successful until the other process has a chance to execute.

Applications that use spin count on single processor systems will not hurt their performance; they just will not benefit.

6.3 Scatter/Gather I/O

Scatter/Gather I/O feature improves the performance of application servers on a network. Its use is entirely transparent to system administrators, because applications can make use of it without any special configuration.

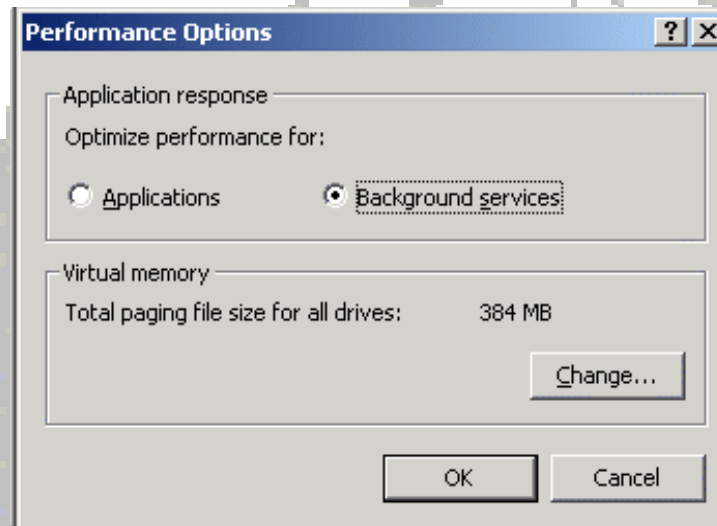
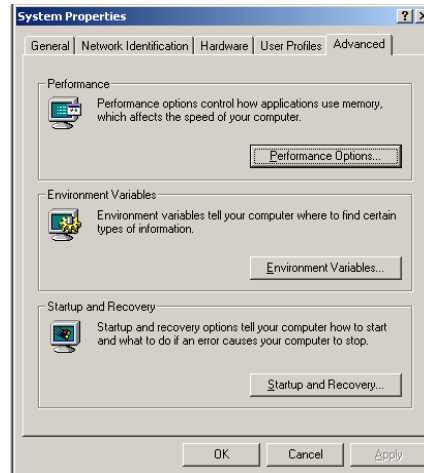
The technology streamlines the process of moving data from discontinuous sections of the system's RAM to a contiguous space on the disk drive. Applications must be written specifically to take advantage of it. Therefore, existing services will not realize any benefit.

6.4 Quantum

A quantum is a property of a thread that defines how long a thread will be allowed to execute before control is handed over to another thread.

Since it takes time to switch the CPU between multiple threads, some applications will benefit from increasing the thread quantum length. The trade-off with this action is that increasing a thread's time slice makes multitasking less smooth.

The quantum type can also be adjusted between fixed length and variable length. This can be configured from the Performance Options dialog box, which is accessed from the Advanced tab of the System Properties dialog box.



Administrators and developers have control over quantum type and length.

- C Giving priority to applications allocates short, variable quanta, providing smoother multitasking.
- C Giving priority to background services causes the operating system to use long, fixed quanta, which improves performance of network services.

By default, Windows Server 2003 gives priority to background services.

6.5 Windows Driver Model

A driver is a piece of software that allows the operating system to communicate with a piece of hardware. All hardware accessories require drivers: network cards, SCSI cards, modems, scanners, and printers.

Older versions of Windows required different drivers for each operating system. This was a burden to hardware vendors who created the drivers and to any administrators who managed multiple operating systems. Windows Server 2003, Windows 2002, and Windows XP systems can use the same drivers.

The WDM Kernel Streaming architecture improves the performance of real-time streaming media. Previous versions of Windows required streaming media applications to do the bulk of processing in user mode. Many of these functions have been moved to kernel mode, where they execute much faster. However, applications must be specifically written to take advantage of the WDM Kernel Streaming, however, so legacy applications will not benefit.

The WDM Still Image Architecture provides operating system level support for scanners and digital cameras.

6.6 EMA: Enterprise Memory Architecture

Memory allocation can create bottlenecks for many large application servers and is particularly true for massive database servers that must handle hundreds of gigabytes of data.

Windows Server 2003 incorporates Enterprise Memory Architecture which allows up to 512 GB of memory to be addressed by servers with 64-bit processors. Although most servers will not require this level of RAM, data warehouses will benefit because data can be manipulated faster in memory than on hard disks.

Applications must be specifically coded to use the Very Large Memory APIs.

6.7 Multiprocessor Capabilities

Windows Server 2003 offers improved multiprocessor support.

Multithreaded applications executing on multiprocessor systems will perform better; developers do not need to write special code to take advantage of the improved scalability.

- C Windows Server 2003, Standard Edition supports 4 processors simultaneously.
- C Windows 2003 Advanced Server, Enterprise Edition supports 8 simultaneous processors.
- C Windows 2003 Advanced Server, Datacenter Edition supports 64 simultaneous processors.
- C Windows 2003 Advanced Server, Web Edition supports 2 simultaneous processors.

Processes can now be pinned to specific processors. Administrators can use the Task Manager to set the processor affinity of a process. This forces the process to use only that specific processor, which can improve performance by reducing the number of processor cache flushes as processes are swapped between processors. A potential drawback with this feature is that it can also reduce performance by not allowing the process to move to the least busy processor.

6.8 I2O Support

I2O (Intelligent I/O Architecture) technology reduces the load on a system's CPU and improves I/O performance. I2O works by adding a dedicated processor that is optimized for input and output operations.

This technology is designed to streamline bandwidth-intensive activities such as realtime audio and video.

7 Clustering

Organizations that depend on their networks require extremely high uptime.

Downtime is caused by several different events:

- C Hardware failures.
- C Application failures.
- C Reboots as a result of configuration changes.
- C Upgrades and patches.

The clustering features of Windows Server 2003 allow two servers to back each other up. When one server fails, a second server can automatically take over those services in less than a minute, in a process known as fail-over. The monitoring services will detect the failure and shift responsibility to the backup server.

For scheduled downtime events, one server can cover for the other server while it is taken offline. This process, called a rolling upgrade, reduces downtime to a minimum when applying patches.

Clustering is designed to allow better scalability by load-balancing requests between multiple machines. In addition to improving uptime by providing fail-over capabilities, many aspects of the operating system are capable of being load balanced. Requests can be automatically distributed between two or more systems, and clients will automatically select a different server in the event one server in a cluster fails.

Clustering services are built into the operating system itself. Cluster-aware administration tools can be used for changing settings to multiple servers simultaneously. Windows Server 2003 clustering capabilities can be utilized/implemented without purchasing any special equipment. Servers in the cluster can have different hardware configurations.

The following components have been improved to support fail-over between systems in a cluster:

| | |
|------|-------------------------------------|
| WINS | Windows Internet Name Service |
| DHCP | Dynamic Host Configuration Protocol |
| Dfs | Distributed File System |

8 Terminal Services

Terminal Services is built in to Windows Server 2003. Terminal services allows clients to run interactive applications on a remote server. The client system accepts input from and displays output to the user. The network infrastructure is used to carry the data between the client system and the server. All processing is done on the server.

Terminal services allows the use of thin clients. A thin client is a desktop system that has a bare minimum of hardware. Instead of requiring end-user systems to have fast processors, large amounts of RAM, and large hard drives, the network Terminal Services will do all the work. The thin client will forward requests to the server. The experience for the user is similar to that of having a fully equipped desktop system. While hardware requirements for the client are minimal, Terminal Services may be used with any type of desktop system.

The light requirements of the clients provide an added benefit to organizations with legacy hardware. Existing Windows for Workgroups 3.11 and Windows 95 systems can act as clients without upgrading the operating system. This allows an older piece of desktop hardware to run new 32-bit applications, increasing its lifetime. Terminal Services clients for Windows NT 4.0, Windows 95, Windows 98, and Windows 2003 Professional or Server are included with Windows Server 2003.

To allow multiple users to each have a session over the network, Windows Server 2003 incorporates a modified Win32 subsystem. The new Win32 subsystem can track different user sessions and keep them separate. Keyboard and mouse input are funneled not only to the proper application, but also to the proper session. Each user does work within his or her own security limitations.

A separate Win32 process is launched for each user session. This ensures that applications do not communicate between user sessions.